Claims

[c1] 1. A method for sensing of vibration of a surface (13), comprising the steps of:
generating a comparison signal (214) by comparing (210) a reflected signal (202) representing ultrasonic radiation (14) as received (12) following a reflection of said ultrasonic radiation (14) off of said surface (13), with a reference signal (206) representing said ultrasonic radiation (14) as emitted (11) toward said surface (13); and
extracting a representation signal (216) by passing through from said comparison signal (214), frequencies lower than a low pass threshold (212).

[c2] 2. The method of claim 1, additionally for self-calibrating said sensing of said vibration of said surface (13), further comprising the steps of:
extracting a deviation signal (220) by passing through from said comparison signal (214), frequencies lower than a low-low pass threshold (218); and
maintaining said deviation signal (220) in a substantially quiescent state and thereby self-calibrating said sensing, by shifting (222, 224, 226) said reference signal (206) relative to said reflected signal (202) in response to said deviation signal (220) straying from said substantially quiescent state.

[c3] 3. The method of claim 1, further comprising the step of:
displaying (228) information pertaining to said vibration of said surface (13), based on said representation signal (216).

[c4] 4. The method of claim 2, further comprising the step of:
displaying (228) information pertaining to said vibration of said surface (13), based on said representation signal (216).

[c5] 5. The method of claim 3, said step of displaying (228) information pertaining to said vibration of said surface (13) further comprising the steps of:
displaying one of the alphabetic characters A, B, C, D, E, F and G representing a musical note corresponding with said vibration of said surface (13);
displaying a musical sharp note indicator if said musical note is sharp;
displaying a musical flat note indicator if said musical note is flat; and
displaying a degree to which said musical note is out of tune.

[c6] 6. The method of claim 4, said step of displaying (228) information pertaining to said vibration of said surface (13) further comprising the steps of:
displaying one of the alphabetic characters A, B, C, D, E, F and G representing a musical note corresponding with said vibration of said surface (13);
displaying a musical sharp note indicator if said musical note is sharp;
displaying a musical flat note indicator if said musical note is flat; and
displaying a degree to which said musical note is out of tune.

[c7] 7. The method of claim 1, said surface (13) comprising a drumhead.

[c8] 8. The method of claim 2, said surface (13) comprising a drumhead.

[c9] 9. The method of claim 1, further comprising the steps of:
emitting (11) said ultrasonic radiation (14) toward said surface (13) using an emitting ultrasonic transducer (11); and
receiving (12) said ultrasonic radiation (14) following said reflection off of said surface (13) using a receiving ultrasonic transducer (12).

[c10] 10. The method of claim 2, further comprising the steps of:
emitting (11) said ultrasonic radiation (14) toward said surface (13) using an emitting ultrasonic transducer (11); and
receiving (12) said ultrasonic radiation (14) following said reflection off of said surface (13) using a receiving ultrasonic transducer (12).

[c11] 11. The method of claim 1, further comprising the steps of:
emitting (11) said ultrasonic radiation (14) toward said surface (13) at a frequency at least approximately ten times as high as a highest vibrational frequency of interest of said surface (13).

[c12] 12. The method of claim 2, further comprising the steps of:
emitting (11) said ultrasonic radiation (14) toward said surface (13) at a frequency at least approximately ten times as high as a highest vibrational frequency of interest of said surface (13).

[c13] 13. The method of claim 9, further comprising the steps of:
locating said ultrasonic transducers (11,12) at least approximately 5 mm. away

from said surface (13); and
locating said ultrasonic transducers (11,12) at most approximately 1 m. away from said surface (13).

[c14] 14. The method of claim 10, further comprising the steps of:
locating said ultrasonic transducers (11,12) at least approximately 5 mm. away from said surface (13); and
locating said ultrasonic transducers (11,12) at most approximately 1 m. away from said surface (13).

[c15] 15. The method of claim 9, further comprising the steps of:
locating said ultrasonic transducers (11,12) at least approximately 2.5 cm. away from said surface (13); and
locating said ultrasonic transducers (11,12) at most approximately 20 cm. away from said surface (13).

[c16] 16. The method of claim 14, further comprising the steps of:
locating said ultrasonic transducers (11,12) at least approximately 2.5 cm. away from said surface (13); and
locating said ultrasonic transducers (11,12) at most approximately 20 cm. away from said surface (13).

[c17] 17. The method of claim 9, further comprising the step of said emitting transducer (11) focusing said ultrasonic radiation (11) to cover substantially a single spot on said surface (13).

[c18] 18. The method of claim 10, further comprising the step of said emitting transducer (11) focusing said ultrasonic radiation (11) to cover substantially a single spot on said surface (13).

[c19] 19. A method for self-calibrating a sensing of vibration of a surface (13), comprising the steps of:
generating a comparison signal (214) by comparing (210) a reflected signal (202) representing ultrasonic radiation (14) as received (12) following a reflection of said ultrasonic radiation (14) off of said surface (13), with a reference signal (206) representing said ultrasonic radiation (14) as emitted (11)

toward said surface (13);

extracting a deviation signal (220) by passing through from said comparison signal (214), frequencies lower than a low-low pass threshold (218);and

maintaining said deviation signal (220) in a substantially quiescent state and thereby self-calibrating said sensing, by shifting (222, 224, 226) said reference signal (206) relative to said reflected signal (202) in response to said deviation signal (220) straying from said substantially quiescent state.

[c20] 20. The method of claim 19, additionally for said sensing of said vibration of said surface (13), further comprising the step of:

extracting a representation signal (216) by passing through from said comparison signal (214), frequencies lower than a low pass threshold (212).

[c21] 21. The method of claim 20, further comprising the step of:

displaying (228) information pertaining to said vibration of said surface (13), based on said representation signal (216).

[c22] 22. The method of claim 21, said step of displaying (228) information pertaining to said vibration of said surface (13) further comprising the steps of:

displaying one of the alphabetic characters A, B, C, D, E, F and G representing a musical note corresponding with said vibration of said surface (13);

displaying a musical sharp note indicator if said musical note is sharp;

displaying a musical flat note indicator if said musical note is flat; and

displaying a degree to which said musical note is out of tune.

[c23] 23. The method of claim 19, said surface (13) comprising a drumhead.

[c24] 24. The method of claim 20, said surface (13) comprising a drumhead.

[c25] 25. The method of claim 19, further comprising the steps of:

emitting (11) said ultrasonic radiation (14) toward said surface (13) using an emitting ultrasonic transducer (11); and

receiving (12) said ultrasonic radiation (14) following said reflection off of said surface (13) using a receiving ultrasonic transducer (12).

[c26] 26. The method of claim 20, further comprising the steps of:

emitting (11) said ultrasonic radiation (14) toward said surface (13) using an emitting ultrasonic transducer (11); and
receiving (12) said ultrasonic radiation (14) following said reflection off of said surface (13) using a receiving ultrasonic transducer (12).

[c27] 27. The method of claim 19, further comprising the steps of:
emitting (11) said ultrasonic radiation (14) toward said surface (13) at a frequency at least approximately ten times as high as a highest vibrational frequency of interest of said surface (13).

[c28] 28. The method of claim 20, further comprising the steps of:
emitting (11) said ultrasonic radiation (14) toward said surface (13) at a frequency at least approximately ten times as high as a highest vibrational frequency of interest of said surface (13).

[c29] 29. The method of claim 25, further comprising the steps of:
locating said ultrasonic transducers (11,12) at least approximately 5 mm. away from said surface (13); and
locating said ultrasonic transducers (11,12) at most approximately 1 m. away from said surface (13).

[c30] 30. The method of claim 26, further comprising the steps of:
locating said ultrasonic transducers (11,12) at least approximately 5 mm. away from said surface (13); and
locating said ultrasonic transducers (11,12) at most approximately 1 m. away from said surface (13).

[c31] 31. The method of claim 25, further comprising the steps of:
locating said ultrasonic transducers (11,12) at least approximately 2.5 cm. away from said surface (13); and
locating said ultrasonic transducers (11,12) at most approximately 20 cm. away from said surface (13).

[c32] 32. The method of claim 26, further comprising the steps of:
locating said ultrasonic transducers (11,12) at least approximately 2.5 cm. away from said surface (13); and

locating said ultrasonic transducers (11,12) at most approximately 20 cm. away from said surface (13).

[c33] 33. The method of claim 25, further comprising the step of said emitting transducer (11) focusing said ultrasonic radiation (11) to cover substantially a single spot on said surface (13).

[c34] 34. The method of claim 26, further comprising the step of said emitting transducer (11) focusing said ultrasonic radiation (11) to cover substantially a single spot on said surface (13).

[c35] 35. An apparatus for sensing of vibration of a surface (13), comprising:
comparator means (210) for generating a comparison signal (214) by comparing (210) a reflected signal (202) representing ultrasonic radiation (14) as received (12) following a reflection of said ultrasonic radiation (14) off of said surface (13), with a reference signal (206) representing said ultrasonic radiation (14) as emitted (11) toward said surface (13); and
low pass filter means (212) for extracting a representation signal (216) by passing through from said comparison signal (214), frequencies lower than a low pass threshold (212).

[c36] 36. The apparatus of claim 35, additionally for self-calibrating said sensing of said vibration of said surface (13), further comprising:
low-low pass filter means (218) for extracting a deviation signal (220) by passing through from said comparison signal (214), frequencies lower than a low-low pass threshold (218); and
self-calibration means (222, 224, 226) for maintaining said deviation signal (220) in a substantially quiescent state and thereby self-calibrating said sensing, by shifting (222, 224, 226) said reference signal (206) relative to said reflected signal (202) in response to said deviation signal (220) straying from said substantially quiescent state.

[c37] 37. The apparatus of claim 35, further comprising:
display means (228) for displaying (228) information pertaining to said vibration of said surface (13), based on said representation signal (216).

[c38] 38. The apparatus of claim 36, further comprising:
display means (228) for displaying (228) information pertaining to said vibration of said surface (13), based on said representation signal (216).

[c39] 39. The apparatus of claim 37, said display means (228) further comprising:
note indicator means for displaying one of the alphabetic characters A, B, C, D, E, F and G representing a musical note corresponding with said vibration of said surface (13);
sharp note indicator means for displaying a musical sharp note indicator if said musical note is sharp;
flat note indicator means for displaying a musical flat note indicator if said musical note is flat; and
out-of-tune indicator means displaying a degree to which said musical note is out of tune.

[c40] 40. The apparatus of claim 38, said display means (228) further comprising:
note indicator means for displaying one of the alphabetic characters A, B, C, D, E, F and G representing a musical note corresponding with said vibration of said surface (13);
sharp note indicator means for displaying a musical sharp note indicator if said musical note is sharp;
flat note indicator means for displaying a musical flat note indicator if said musical note is flat; and
out-of-tune indicator means displaying a degree to which said musical note is out of tune.

[c41] 41. The apparatus of claim 35, said surface (13) comprising a drumhead.

[c42] 42. The apparatus of claim 32, said surface (13) comprising a drumhead.

[c43] 43. The apparatus of claim 35, further comprising:
emitting ultrasonic transducer means (11) for emitting (11) said ultrasonic radiation (14) toward said surface (13); and
receiving ultrasonic transducer means (12) for receiving (12) said ultrasonic radiation (14) following said reflection off of said surface (13).

[c44] 44. The apparatus of claim 36, further comprising:
emitting ultrasonic transducer means (11) for emitting (11) said ultrasonic radiation (14) toward said surface (13); and
receiving ultrasonic transducer means (12) for receiving (12) said ultrasonic radiation (14) following said reflection off of said surface (13).

[c45] 45. The apparatus of claim 35, further comprising:
emitting ultrasonic transducer means (11) for emitting (11) said ultrasonic radiation (14) toward said surface (13) at a frequency at least approximately ten times as high as a highest vibrational frequency of interest of said surface (13).

[c46] 46. The apparatus of claim 36, further comprising:
emitting ultrasonic transducer means (11) for emitting (11) said ultrasonic radiation (14) toward said surface (13) at a frequency at least approximately ten times as high as a highest vibrational frequency of interest of said surface (13).

[c47] 47. The apparatus of claim 43, wherein:
said ultrasonic transducers (11,12) are located at least approximately 5 mm. away from said surface (13); and
said ultrasonic transducers (11,12) are located at most approximately 1 m. away from said surface (13).

[c48] 48. The apparatus of claim 44, wherein:
said ultrasonic transducers (11,12) are located at least approximately 5 mm. away from said surface (13); and
said ultrasonic transducers (11,12) are located at most approximately 1 m. away from said surface (13).

[c49] 49. The apparatus of claim 43, wherein:
said ultrasonic transducers (11,12) are located at least approximately 2.5 cm. away from said surface (13); and
said ultrasonic transducers (11,12) are located at most approximately 20 cm. away from said surface (13).

[c50] 50. The apparatus of claim 44, wherein:
said ultrasonic transducers (11,12) are located at least approximately 2.5 cm.

away from said surface (13); and
said ultrasonic transducers (11,12) are located at most approximately 20 cm. away from said surface (13).

[c51] 51. The apparatus of claim 43, said emitting transducer means (11) focusing said ultrasonic radiation (11) to cover substantially a single spot on said surface (13).

[c52] 52. The apparatus of claim 44, said emitting transducer means (11) focusing said ultrasonic radiation (11) to cover substantially a single spot on said surface (13).

[c53] 53. An apparatus for self-calibrating a sensing of vibration of a surface (13), comprising:
comparator means (210) for generating a comparison signal (214) by comparing (210) a reflected signal (202) representing ultrasonic radiation (14) as received (12) following a reflection of said ultrasonic radiation (14) off of said surface (13), with a reference signal (206) representing said ultrasonic radiation (14) as emitted (11) toward said surface (13);
low-low pass filter means (218) for extracting a deviation signal (220) by passing through from said comparison signal (214), frequencies lower than a low-low pass threshold (218); and
self-calibration means (222, 224, 226) for maintaining said deviation signal (220) in a substantially quiescent state and thereby self-calibrating said sensing, by shifting (222, 224, 226) said reference signal (206) relative to said reflected signal (202) in response to said deviation signal (220) straying from said substantially quiescent state.

[c54] 54. The apparatus of claim 53, additionally for said sensing of said vibration of said surface (13), further comprising:
low pass filter means (212) for extracting a representation signal (216) by passing through from said comparison signal (214), frequencies lower than a low pass threshold (212).

[c55] 55. The apparatus of claim 54, further comprising:

display means (228) for displaying (228) information pertaining to said vibration of said surface (13), based on said representation signal (216).

[c56] 56. The apparatus of claim 55, said display means (228) further comprising:
note indicator means for displaying one of the alphabetic characters A, B, C, D, E, F and G representing a musical note corresponding with said vibration of said surface (13);
sharp note indicator means for displaying a musical sharp note indicator if said musical note is sharp;
flat note indicator means for displaying a musical flat note indicator if said musical note is flat; and
out-of-tune indicator means displaying a degree to which said musical note is out of tune.

[c57] 57. The apparatus of claim 53, said surface (13) comprising a drumhead.

[c58] 58. The apparatus of claim 54, said surface (13) comprising a drumhead.

[c59] 59. The apparatus of claim 53, further comprising:
emitting ultrasonic transducer means (11) for emitting (11) said ultrasonic radiation (14) toward said surface (13); and
receiving ultrasonic transducer means (12) for receiving (12) said ultrasonic radiation (14) following said reflection off of said surface (13).

[c60] 60. The apparatus of claim 54, further comprising:
emitting ultrasonic transducer means (11) for emitting (11) said ultrasonic radiation (14) toward said surface (13); and
receiving ultrasonic transducer means (12) for receiving (12) said ultrasonic radiation (14) following said reflection off of said surface (13).

[c61] 61. The apparatus of claim 53, further comprising:
emitting ultrasonic transducer means (11) for emitting (11) said ultrasonic radiation (14) toward said surface (13) at a frequency at least approximately ten times as high as a highest vibrational frequency of interest of said surface (13).

[c62] 62. The apparatus of claim 54, further comprising:

emitting ultrasonic transducer means (11) for emitting (11) said ultrasonic radiation (14) toward said surface (13) at a frequency at least approximately ten times as high as a highest vibrational frequency of interest of said surface (13).

[c63] 63. The apparatus of claim 59, wherein:
said ultrasonic transducers (11,12) are located at least approximately 5 mm. away from said surface (13); and
said ultrasonic transducers (11,12) are located at most approximately 1 m. away from said surface (13).

[c64] 64. The apparatus of claim 60, wherein:
said ultrasonic transducers (11,12) are located at least approximately 5 mm. away from said surface (13); and
said ultrasonic transducers (11,12) are located at most approximately 1 m. away from said surface (13).

[c65] 65. The apparatus of claim 59, wherein:
said ultrasonic transducers (11,12) are located at least approximately 2.5 cm. away from said surface (13); and
said ultrasonic transducers (11,12) are located at most approximately 20 cm. away from said surface (13).

[c66] 66. The apparatus of claim 60, wherein:
said ultrasonic transducers (11,12) are located at least approximately 2.5 cm. away from said surface (13); and
said ultrasonic transducers (11,12) are located at most approximately 20 cm. away from said surface (13).

[c67] 67. The apparatus of claim 59, said emitting transducer means (11) focusing said ultrasonic radiation (11) to cover substantially a single spot on said surface (13).

[c68] 68. The apparatus of claim 60, said emitting transducer means (11) focusing said ultrasonic radiation (11) to cover substantially a single spot on said surface (13).